Body Sensor Networks: Can we use them?

Architecture proposal for resource abstraction

Pedro Brandão and Jean Bacon

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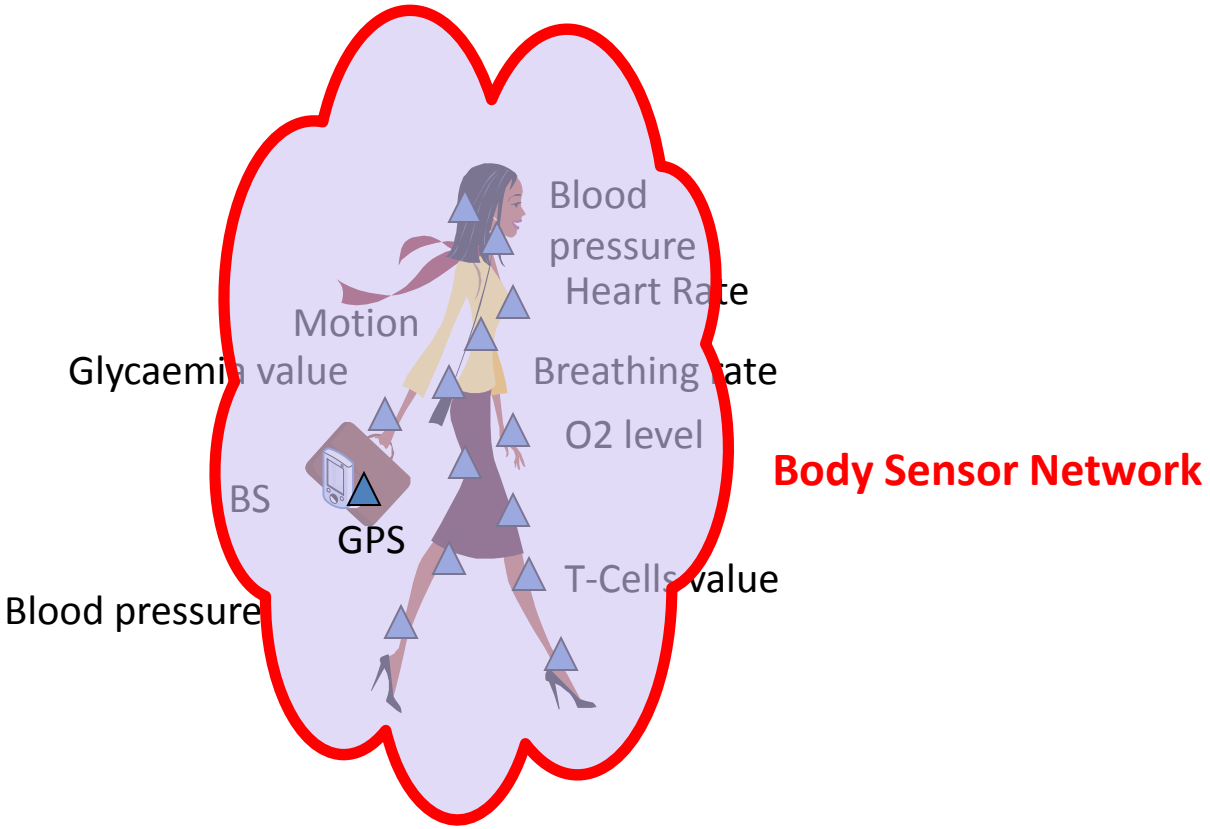
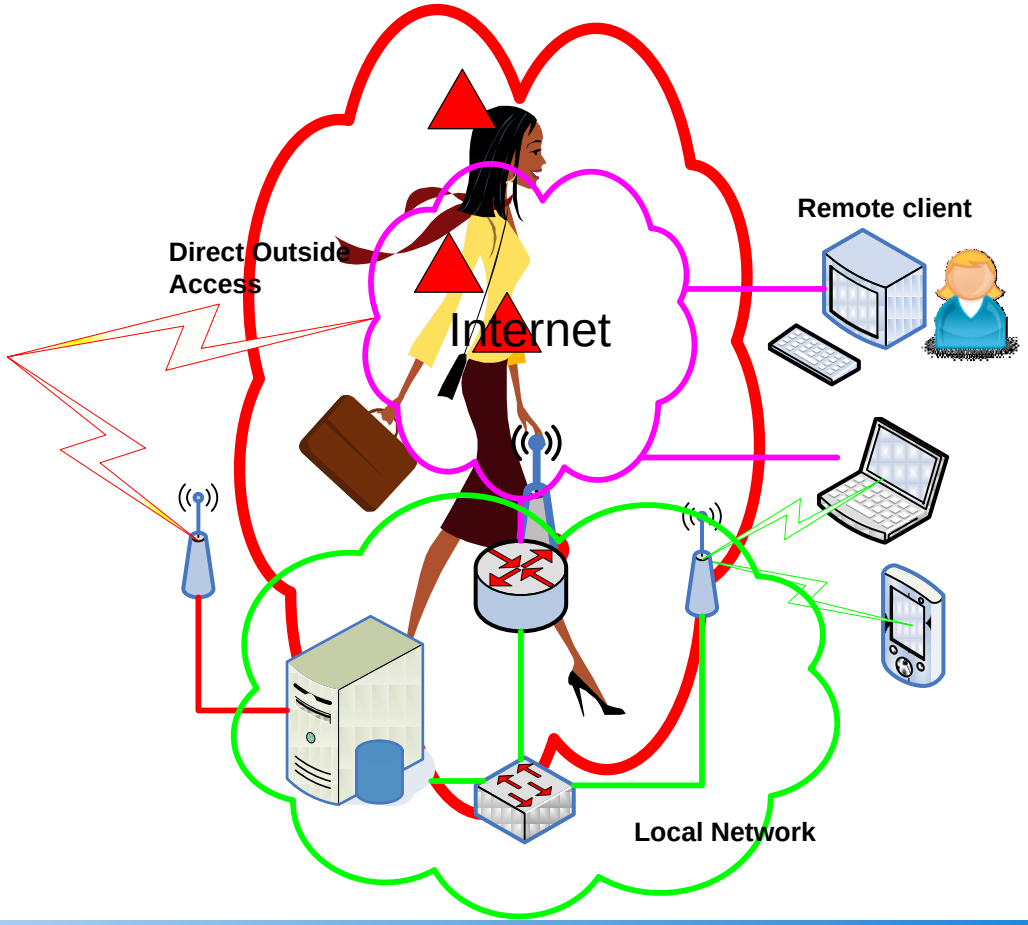
Body Sensor Network



Body Sensor Network



What is it for? Monitoring

- Sport
  - Self-assessment
  - Team performance
- Health
  - At home
  - More effectively/comfortably at hospitals
  - Triage
  - 1st responders
- Human Computer Itf
  - Impaired persons
  - Gaming
- …



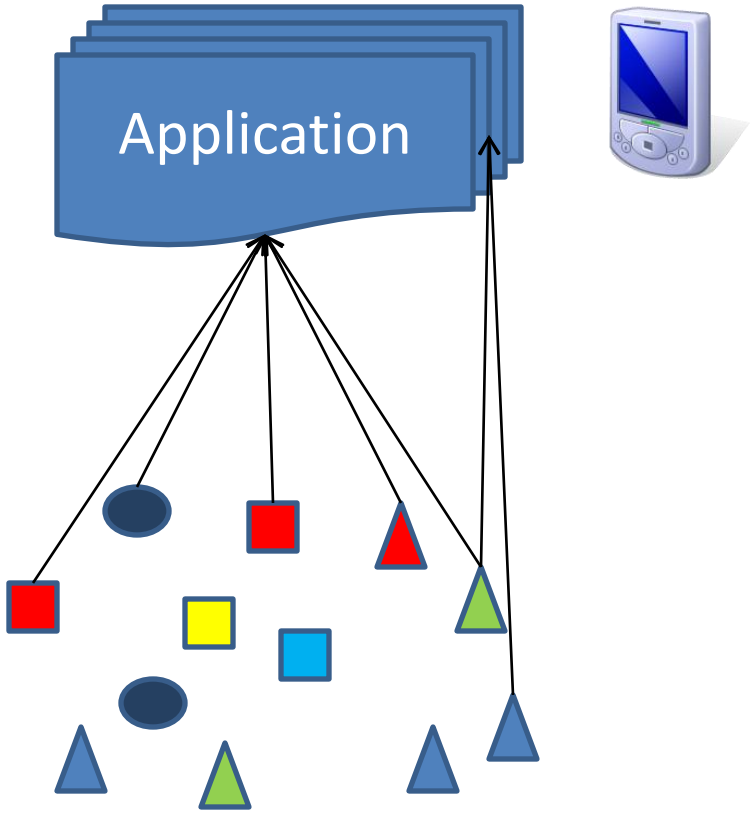



And there is also Actuating…

Motivation

App Heterogeneity

Sensor Heterogeneity

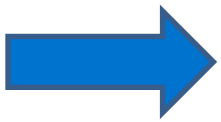


Diff to WSN

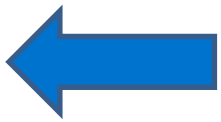
- Existence of a central node (Base Station (BS))
- One Hop Communication
- Sensor heterogeneity
- Data heterogeneity
- Application heterogeneity
- Changing interest on the data

Holistic information

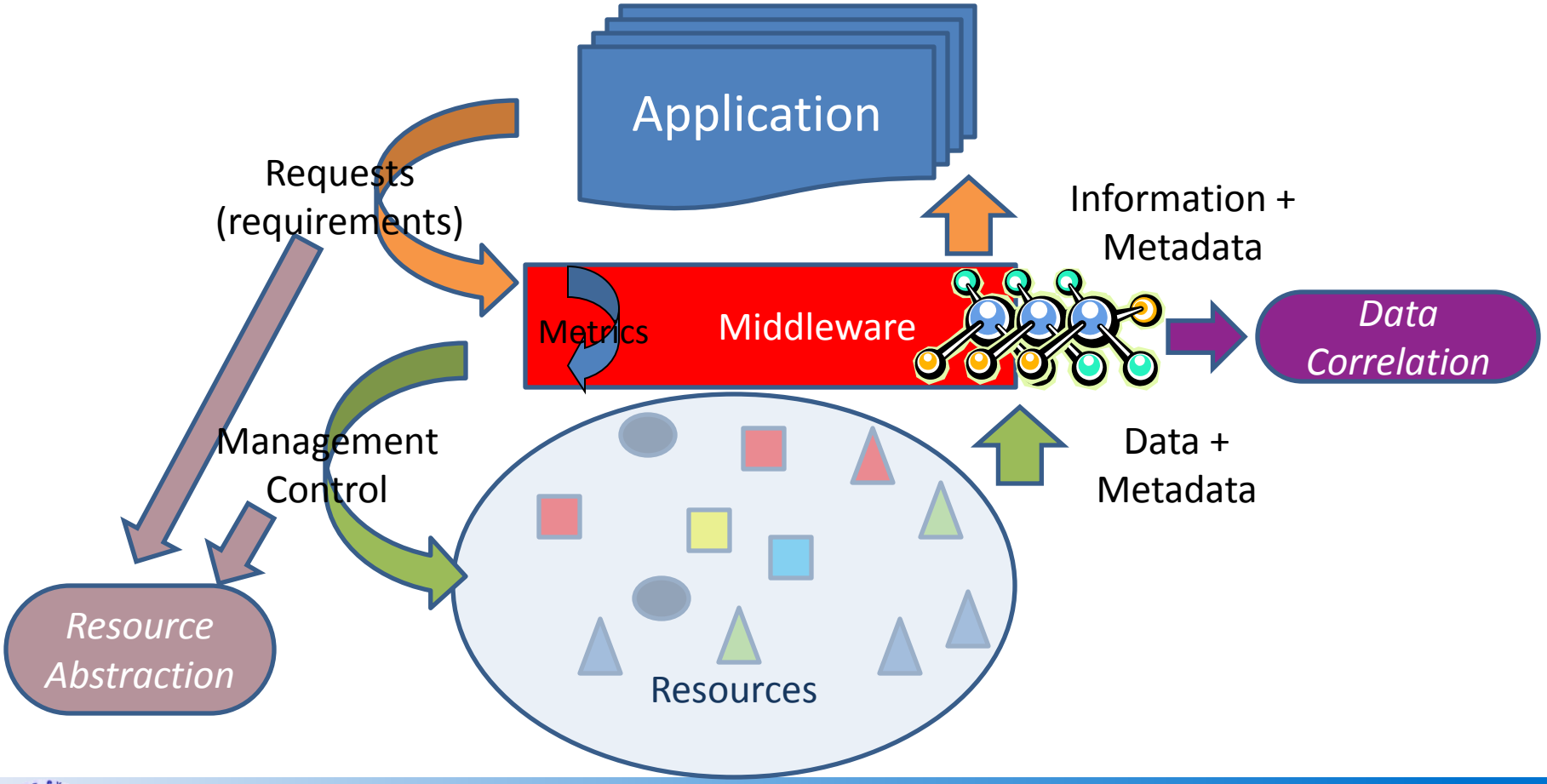
Data Correlation



Resource Abstraction



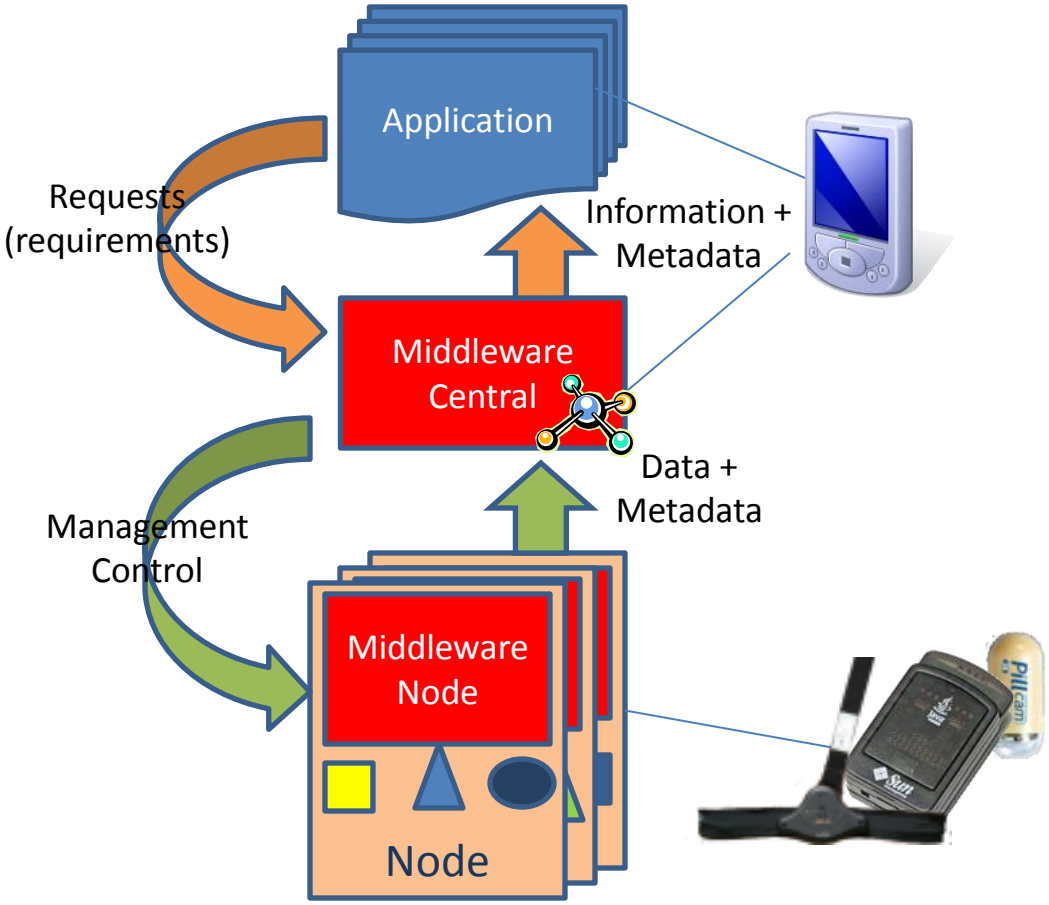
Middleware Approach



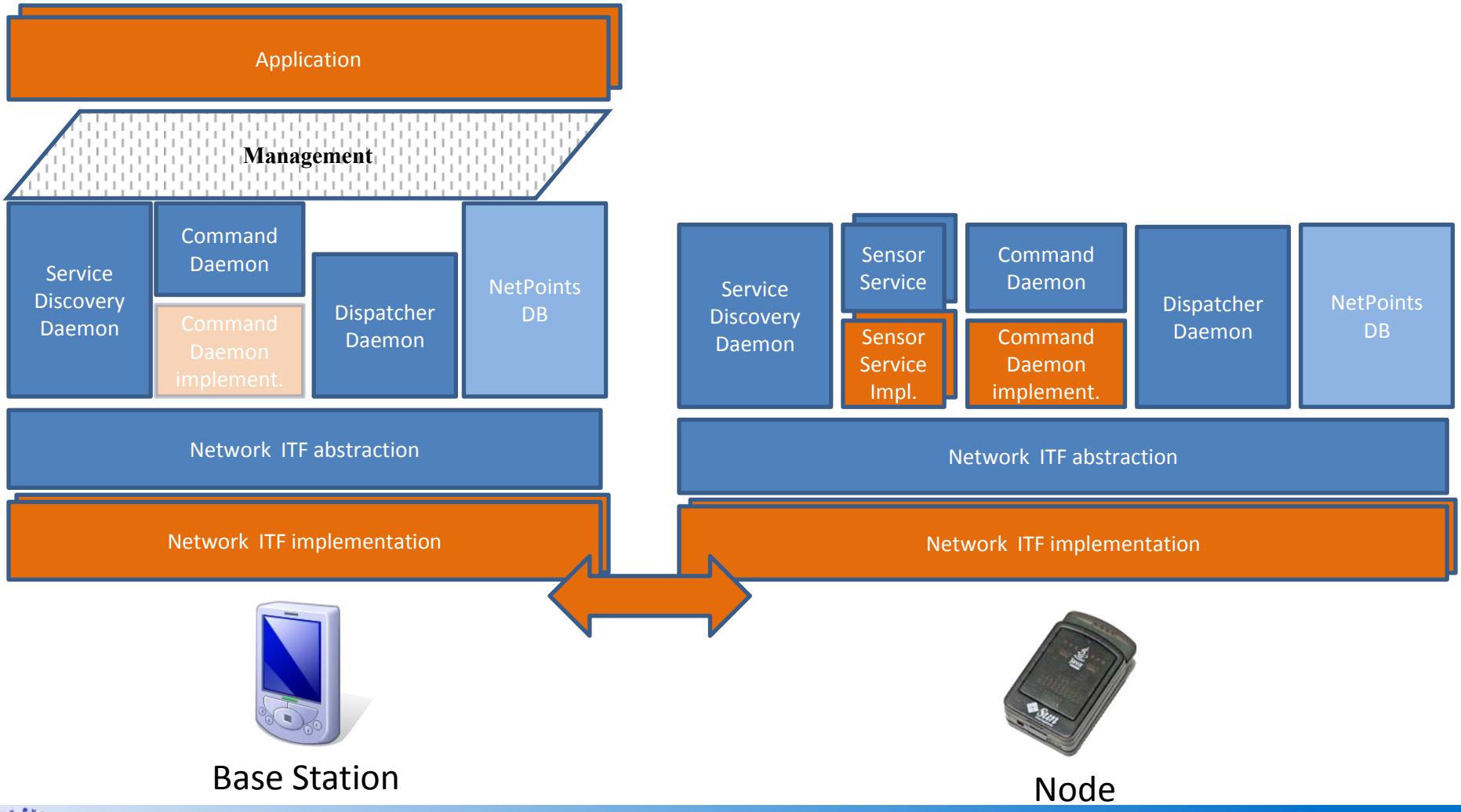
Why is it hard for the apps...

- Lack of a common framework
  - Have to manage each HW sensor;
  - No way to specify requirements;
  - Optimization/management is apps responsibility
- Ability to correlate data from the sensors
  - And specify requests/requirements on it;
- Dynamicity of the system:
  - PnP for added sensors;
  - Nodes dying;

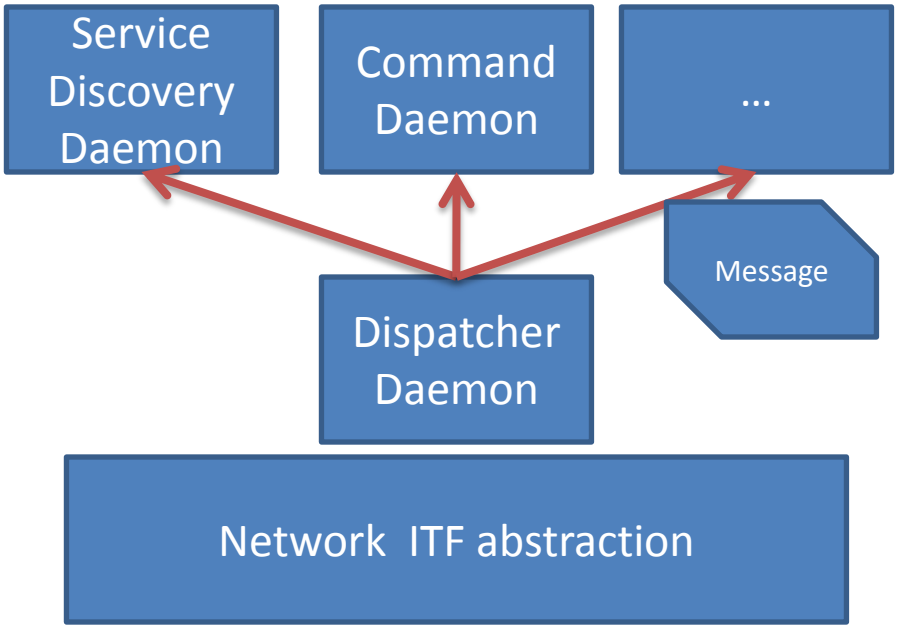
Architecture



Deployment/Components



Daemons

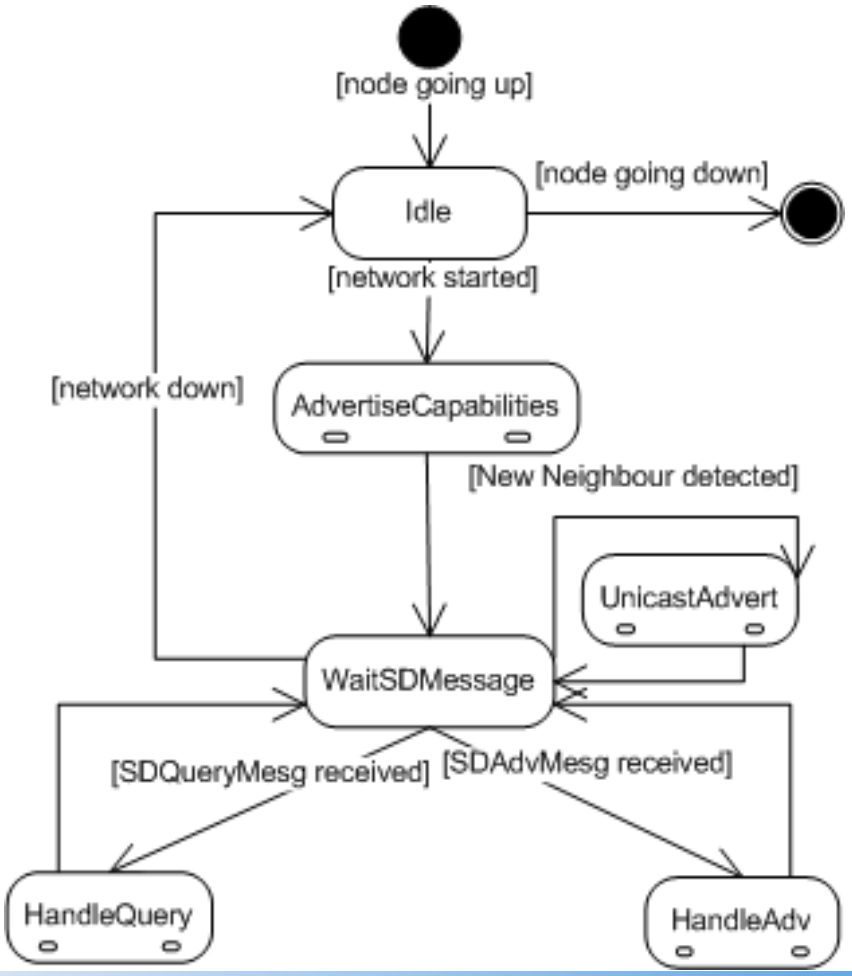


Datagram

Handles Fragmented Datagrams

Service Discovery

State Machine diagrams

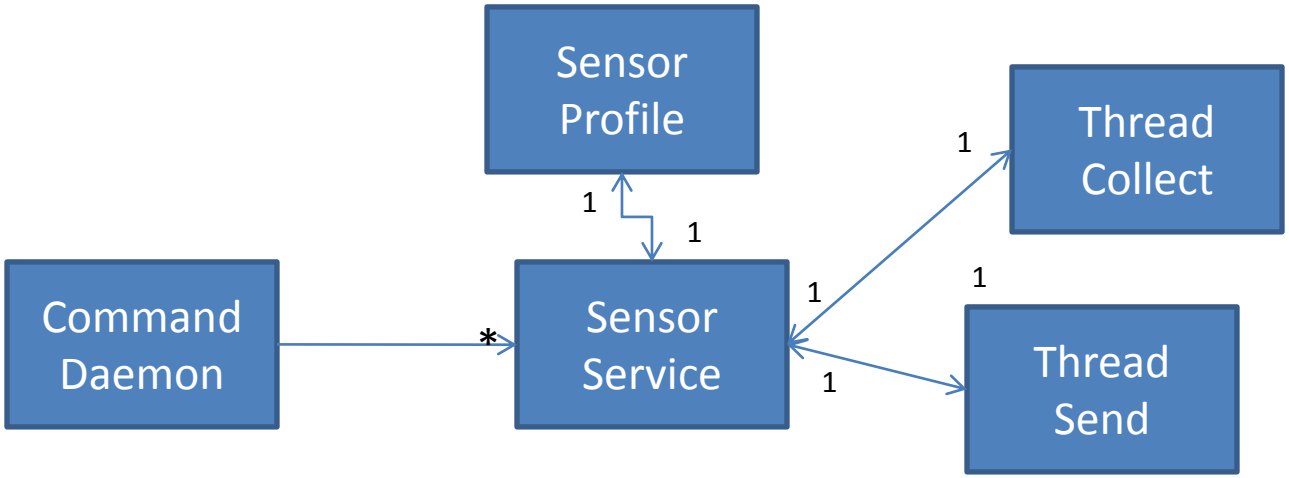


- On BS 
  - It reacts to queries by looking in internal DB and sending query messages (if needed)
  - Receives and stores info on advertisements
- On nodes 
  - Sends advertisements on start and when queried
  - **Note**: the nodes could also forward queries and send replies pointing to other nodes, but this is disabled in the implementation for BSNs

Service Discovery Objectives

- **Query capability:** the query mechanism should be flexible to allow generic matching of capabilities;
- **Profile flexibility:** it should be relatively easy to introduce a new profile description so to be able to advertise a new capability;
- **Overhead:** the overhead added should be kept to a minimum;
- **Lower Layer Interaction:** when possible it should be possible to build on functionality already provided by lower layers (eg.: notification of a new node);
- **Energy aware:** the SD should be as power efficient as possible so not to increase exceedingly (when compared to not using it) energy consumption.

Command Daemon



Command Daemon implementation

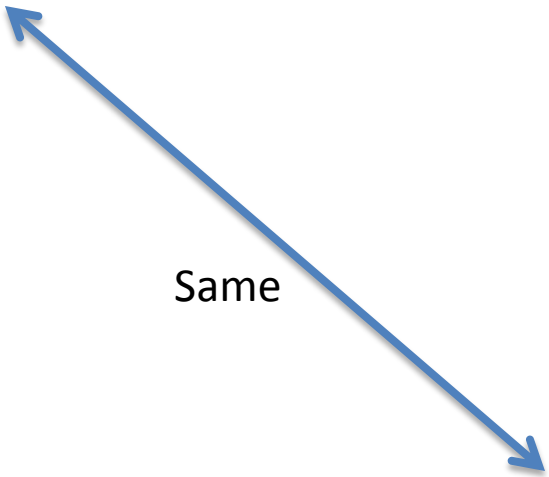
Sensor Service implementation

To:
- handle the on/off of the Node
- build the specific SensorServices

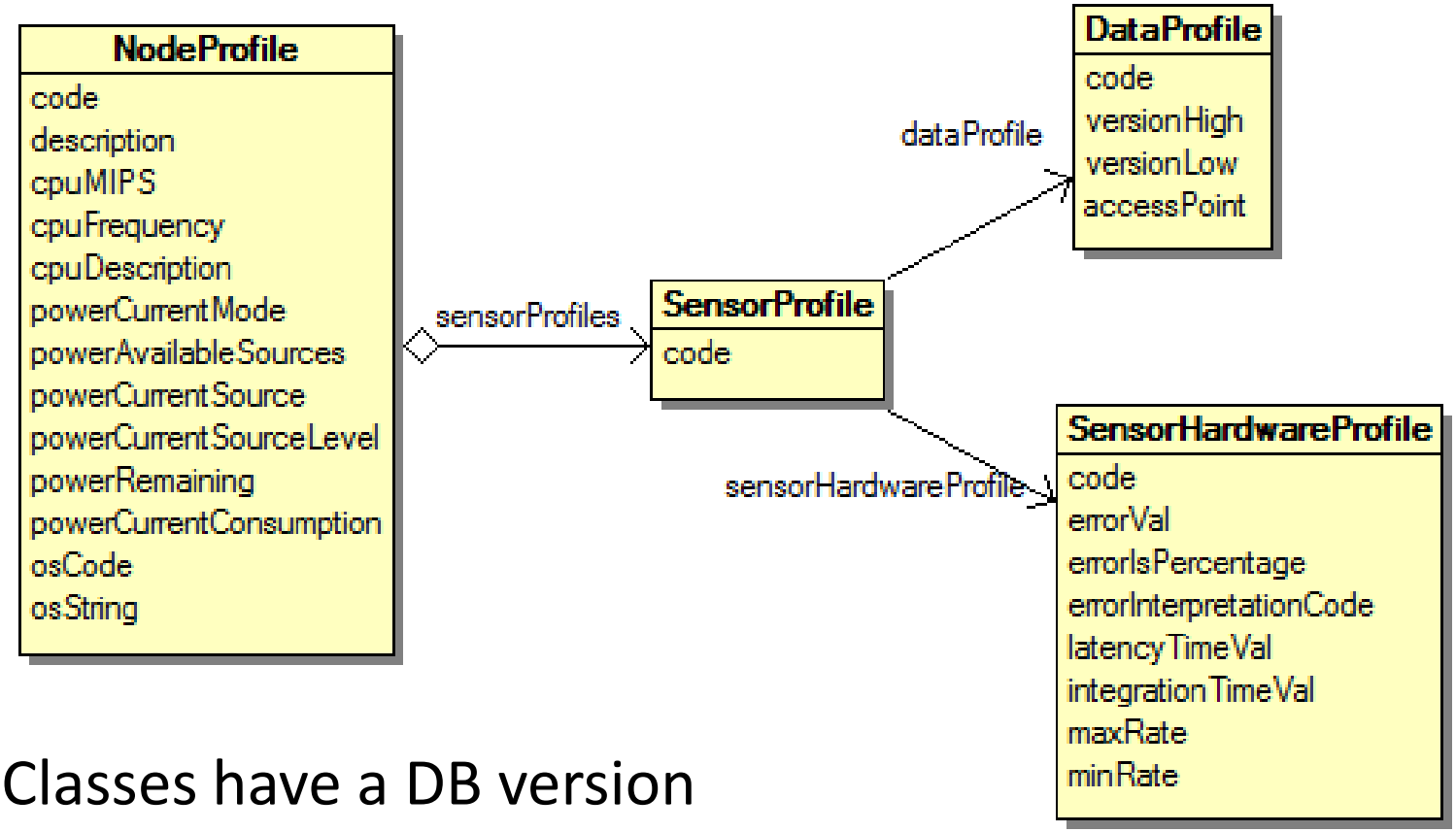
For the reading of the specific sensor

Messages

- Service Discovery
  - Ack/Nack
  - Advert
  - Query
- Commands
  - Reading Requests
  - Reading Replies
  - Rate Change
    - Collection
    - Sending
  - Node State change
  - Ack/Nack



Data Structures: Profile Classes



- Classes have a DB version
  - Has the default instances (SunSpot, Mica2, etc)
  - Knows how to code/decode to/from wire format

Other Implementation Info

- Developed on SunSpots
  - Temperature, Light, 3D accelerometer
  - Run Java on Squawk VM
  - 512KB RAM, ARM920T (180MHz), 4MB Flash, 802.15.4
  - BS is laptop
- Lib size: 120KB, but...
  - Generic implementation (the same code on BS and node);
  - Specific implementation (network) can also be shared;
  - Instantiation and usage is however different.

Conclusion

- Framework for:
  - Resource (HW) abstraction;
  - Management/optimization of resources;
  - Aggregation/correlation of sensed data using modelling;
  - Managing requests/requirements from apps;
- Reg. Resource (HW) abstraction
  - Protocol and data structures defined
  - Service discovery capable;
  - Prototype developed;

Data Correlation

Resource Abstraction

Future work

- Add to the sensor heterogeneity:
  - Add Equivital platform;
- Management layer:
  - Models' usage;
  - Handling requirements;
  - Optimization;
- Security:
  - Advertising/communicating to/with the intend BS.

BSN: We can not use them in a holistic view, yet... ☺

References

- [CodeBlue] Shnayder, V., Chen, B., Lorincz, K., Fulford-Jones, T. R. F., AND Welsh, M. 2005. Sensor networks for medical care. Tech. rep., Division of Engineering and Applied Sciences Harvard University.
- [LiteMWBAN] Waluyo, A. B., Pek, I., Ying, S., WU, J., Chen, X., and Yeoh, W.-S. 2008. Litemwban: A lightweight middleware for wireless body area network. Medical Devices and Biosensors, 2008. ISSS-MDBS 2008. 5th International Summer School and Symposium on, 141–144.
- [MILAN] Heinzelman, W. B., Murphy, A. L., Carvalho, H. S., and Perillo, M. A. 2004. Middleware to support sensor network applications. Network, IEEE 18, 6–14.

Thank you for listening.

Pedro.Brandao@cl.cam.ac.uk